Advice on Voluntary Settlements for California's Bay-Delta Water Quality Control Plan Part 1: Addressing a Manageable Suite of Ecosystem Problems

Posted on February 13, 2018 by UC Davis Center for Watershed Sciences

by Jeffrey Mount, PPIC Water Policy Center

Recommendation

The State Water Resources Control Board and the parties seeking to incorporate voluntary settlement agreements in the Bay-Delta Water Quality Control Plan should identify a specific, tractable set of problems that can be addressed over the next 15 years through this plan. We urge the participants to focus a near-term Delta plan on:

1) increasing food-web productivity in the Delta,

2) maximizing high-quality habitat that favors native plants and animals, and

3) improving water quality through nutrient management.

These efforts should recognize the inadequacies of actions focused on single species recovery, and instead focus on the simultaneous and integrated management of flows, tides, and landscapes to improve overall ecosystem function and condition.

Introduction

The State Water Resources Control Board is revising its Bay-Delta Water Quality Control Plan. The plan is critical for water management because it prescribes water quality and flow requirements in the Sacramento-San Joaquin River and Delta. The Board is considering incorporating Voluntary Settlement Agreements between affected parties to guide development of its water quality plan.

Members of the Brown administration asked a small group of us to offer views on elements that should be considered in such settlements. Each of us met the following criteria: 1) are not part of the settlement negotiations, 2) do not represent any interested stakeholder, and 3) have expertise in water and ecosystem management in the Delta watershed and the San Francisco Estuary. We have prepared three blog posts that reflect our discussions and conclusions. This is the first in the series.

The Delta Challenge

Balancing the competing interests for water in the Delta and its watershed is one of California's most vexing water policy challenges. This challenge stems from the high economic value of this water throughout the watershed and to export areas, and the highly disrupted ecological conditions of the rivers, the Delta, and the greater San Francisco Estuary. Management for "co-equal" goals, as required by the Delta Reform Act, involves difficult trade-offs that can never fully satisfy all interests.

While there can be value in seeking to simultaneously address all of the many Delta challenges, we think it is more realistic to identify a smaller, well-defined set of problems that can be addressed in the near term (15 years for purposes of this

discussion). This requires identifying a set of linked priority actions that might help address ecosystem problems while providing information about how to better manage the Delta in the future. And because we are uncertain about their effectiveness, any suite of actions must include adequate funding and suitable governance for the science needed to test and refine these actions.

Here we recommend three problem areas to address over the next 15 years, as well as three management tools to use in addressing these problems. Two subsequent posts will recommend priority actions and explore possible funding and governance structures.

Toward a Manageable Set of Delta Problems

The Delta and its watershed have many problems. Some will require decades to address (e.g., adaptation to sea level rise and climate change, and improving storage and conveyance). We recommend that the settlement agreements emphasize problems that can be addressed in the near term and help build foundations for long-term solutions. We focused on three fundamental ecological problems:

- ***The Delta has become a low-productivity estuary***. Reclamation of the Delta landscape eliminated 98% of its high-productivity wetland habitats, leaving an estuary where growth of fish and invertebrates is limited by a small food supply. Low productivity at the base of food webs constrains our ability to meet biological goals for the Delta (Cloern et al. 2016).
- ***Ecosystem conditions favor non-native plants and animals over many native species.*** Current conditions support novel assemblages of organisms that have no historic analog and are difficult to manage. Many non-native species prey on or compete with desirable native fishes. Invasive clams deplete food web productivity. And non-native aquatic vegetation reduces habitat quality for native species and promotes non-native predatory fish (Brown et al. 2016).
- ***Water quality is declining.*** Degradation of water quality by nutrients, pesticides, and other contaminants is affecting human uses of Delta water for recreation and water supply and likely causing harm to native species. An example is the increasing occurrence of blooms of the toxic cyanobacteria *Microcystis* (Lehman et al. 2010, Brooks et al. 2012*)*.

For several decades, Delta water management has been driven by efforts to recover several fish species listed under the federal and state Endangered Species Acts. These fishes are no longer reliable indicators of changing ecosystem condition, due to their small population sizes. We recommend that the settlement agreements and the Water Quality Control Plan take an ecosystem-based approach that explicitly recognizes that addressing these three fundamental problems will improve conditions for a wide range of terrestrial, wetland, and aquatic plants and animals—including listed fish species—as well as human uses of Delta water.

Three Tools to Address These Delta Problems

To improve productivity, habitat, and water quality, the Water Quality Control Plan will need to employ a range of tools. These include:

- ***Managing freshwater flows.*** Regulating flows into and out of the Delta has been the primary emphasis of past water management actions, and will continue to be important. The focus has been on setting minimum flow and water quality requirements that result in outflow from the Delta into San Francisco Bay, and on regulating export flows when fishes of concern are likely to be harmed by export pumping (Gartrell et al. 2017). A range of flow attributes will need to be managed to address the three near-term ecological problems discussed above. These include: flow regime (frequency, magnitude, duration, timing), quality (including salinity, nutrients, and toxins), and the geographic application of freshwater flows. Flow management will be more effective in confined regions where existing flows are small, rather than broadly across the entire Delta (Brown et al. 2008). More ecologically-effective flow management will require flexibility to respond to new information and changing climatic and hydrologic conditions (Mount et al. 2017).
- ***Managing tides.*** Water quality and circulation in the estuary is largely driven by tides. For most of the Delta, tidal flows dwarf freshwater inflows, particularly in dry times. Historic management of the Delta has viewed tides as a constraint, rather than an opportunity to improve ecosystem conditions. New approaches must accommodate or harness tidal energy to meet flow, habitat, and water quality objectives. This includes considering how changes in inflows and landscapes in one area may affect tidal energy elsewhere (Enright 2014).
- ***Managing landscapes.*** Although most of the focus on Delta management has been on flows, the historic transformation of the Delta through channelization and reclamation of wetlands has arguably had a greater impact on ecosystems. To use freshwater inflows and manage tidal energy more effectively, alterations of flow must be paired with strategic changes to the landscape. These changes may include reconnecting landscapes to tidal action and flood flows and altering existing channels in ways that improve ecological conditions and water quality (Robinson et al. 2016, Durand 2017).

These three tools—managing freshwater flows, tides, and landscapes—must be applied in concert to address the three near-term problems identified here. Applying any one of these tools without the others substantially reduces the likelihood of success.

This blog post summarizes some of the ideas generated by an informal group of experts who have met several times to explore concepts for better management of the Delta. Group members include (in alphabetical order): Jon Burau (US Geological Survey [USGS]), Jim Cloern (USGS), John Durand (UC Davis), Greg Gartrell (consulting engineer), Brian Gray (PPIC), Ellen Hanak (PPIC), Carson Jeffres (UC Davis), Wim Kimmerer (SFSU), Jay Lund (UC Davis), Jeffrey Mount (PPIC), and Peter Moyle (UC Davis).

Advice on Voluntary Settlements for California's Bay-Delta Water Quality Control Plan Part 2: Recommended Actions to Improve Ecological Function in the Delta

Posted on February 21, 2018 by UC Davis Center for Watershed Sciences

*by Jeffrey Mount, PPIC Water Policy Center**

The Sacramento-San Joaquin Delta.

Recommendation

By strategically linking freshwater flow releases with the management of tidal energy and investments in landscape changes in the Delta, it is possible to improve ecological food webs and habitat for native species and reduce the effects of pollutants. Projects to address these problems should be concentrated in the North Delta and Suisun Marsh, and can be completed within 15 years. These include habitat improvements on flood bypasses, terminal channels, shallow open-water habitat, river-tide transition zones, and tidal marshlands, along with strategies for reducing harmful algal blooms. This integrated, ecosystem-based approach—in which freshwater flows, tides, and landscapes are managed together—is preferable to current approaches that manage them mostly in isolation from one another, and for a few species of fish.

Introduction

The State Water Board is preparing a new Bay-Delta Water Quality Control Plan. Parties affected by this plan are attempting to negotiate voluntary settlement agreements for the Board to consider. A group of us—experts on the Delta and not part of any negotiations or representing any interested parties*—have come up with a series of recommendations to help inform these negotiations. This is the second in a series of three blog posts that reflect our discussions and conclusions. In our previous post, we recommended that negotiating parties and the Board identify and focus on a set of

ecological goals for the Sacramento-San Joaquin Delta that could be achieved over the next 15 years. That post also lays out our view of the problems facing the Delta and the tools that can be used to better manage it. Here we recommend near-term actions with the greatest likelihood of achieving significant and measurable progress in improving ecosystem conditions.

These recommendations are based principally on the professional judgment of the group, guided by a set of constraints on Delta management that will need to be taken into account (see text box). Many of the actions will be familiar to those working on ecosystem issues in the Delta.

Some Realities for Delta Ecosystem Management

- ***The Delta is a novel ecosystem***. Historical alterations of the Delta's landscape, the introduction of numerous non-native species, and changes in freshwater inflow have irreversibly altered the Delta and its ecosystem. Rather than trying to restore past conditions, management should focus on improving ecosystem function to create and sustain desirable ecosystem conditions into the future (Moyle et al. 2012, 2014).
- ***The Delta is changing***. All Delta ecosystem management is experimental, requiring the capacity to adjust and adapt to new knowledge and changing conditions (Wiens et al. 2017). Over-reliance on narrowly prescriptive, inflexible regulatory actions has failed to meet management objectives (e.g., Gore et al. 2018).
- ***Some native fishes are no longer good indicators of ecosystem conditions***. Populations of Delta smelt, longfin smelt, and winter-run Chinook salmon have declined to the point where fish surveys collect too few fish to provide useful indices of ecosystem conditions. Managing the Delta and its watershed for threatened or endangered species with small populations distorts priorities and makes it difficult to measure progress.
- ***Migratory fishes may provide a better measure of ecosystem conditions***. Management efforts to improve ecosystem conditions can be assessed through the responses of abundant species that use the system at particular times and places. Fishes that migrate through the San Francisco estuary and the watershed—including Sacramento splittail, white sturgeon, striped bass and most runs of salmon—integrate the effects of management practices throughout the ecosystem.
- ***Within the Delta there is a north-south difference in ecosystem conditions and habitat potential***. The North Delta has larger freshwater inflows, higher land elevations, better water quality, and a greater abundance of native species. The Central and South Delta have deeply subsided islands, lower inflows, greater impacts from export pumping, poorer water quality, and few native fishes. Near-term investments in the North Delta are likely to yield higher ecosystem benefits at lower cost than investments in the Central and South Delta (Moyle et al. 2012).
- ***Solutions for the Delta involve the entire estuary and watershed***. Migratory and resident fishes of the Delta are affected by water and land use upstream of the Delta as well as actions throughout the estuary. A holistic approach for the estuary and watershed is more likely to solve problems in the Delta than a narrowly Delta-centric approach.

Management Options to Improve Delta Ecosystem Conditions
The Delta and its watershed face many different environmental problems, and multiple tools are available to address them. There are three general management options (all include a commitment to improve water quality through management of pollutants):

1. **Focus on flow volumes:** Emphasize allocation of freshwater flows to the ecosystem, with significant increases in outflow from the Delta into San Francisco Bay and the ocean.
2. **Focus on landscape management:** Improve habitat through landscape management with no major changes in the current allocation of freshwater flows.
3. **Use a portfolio of actions**: Increase flexibility in the timing and magnitude of freshwater flows and link these to landscape modifications that increase habitat benefits and take advantage of tidal energy (described below).

All three approaches have scientific merits and uncertainties; they also present different social and economic trade-offs. The first—significant increases in Delta outflows—is based on the historical connection between cool, wet years and improved population counts of some species, including pelagic fishes. This relationship is no longer as clear, however, particularly for Delta smelt (see the text box). To fully test this approach the Board would have to re-allocate very large amounts of water to outflow, because modest, incremental changes in outflow are unlikely to result in substantial changes in Delta conditions. This would have large impacts on available water supplies.

The second approach—relying principally on landscape changes to improve conditions—seeks to reverse some of the extensive losses in habitat caused by land reclamation, channelization, and flood control projects. Like the high outflow approach, this too has merit. But it ignores the importance of flow timing and magnitude to ecosystem functions and the life-history requirements of desirable plants and animals.

In our view, the third option—a portfolio that includes increased flexibility in how flows are managed, improvements in landscapes, and management of tides—has the highest likelihood of substantially improving ecosystem conditions. This approach also has the best chance of improving our understanding of how to manage the Delta in the future. To be effective, this option will involve reconnecting significant, contiguous areas of land—some currently held in private ownership—to freshwater flows and tides. This will require both the cooperation of Delta landowners and funding to acquire and manage these lands. Changes in flow management could also introduce some new constraints on water availability for human uses. However, by targeting flow releases we expect that this portfolio approach has the potential to use water, land, and financial resources most efficiently to improve ecosystem conditions in the Delta.

We next briefly describe what we mean by management of freshwater flows and tides. We then outline six project areas for the recommended portfolio approach.

Managing Freshwater Flows

Managing fresh water in conjunction with the landscape and tides will require water users and regulators to shift away from the current approach—which focuses on adhering to minimum instream flow and water quality regulations—toward more flexible management. Flexibility includes allowing for real-time adjustments to hydrologic conditions (for example, to take advantage of pulse flows from storms), experimental flows to test ecological responses to landscape changes, and strategic use of flows to improve water quality. This also involves narrowly targeting flows to improve ecological conditions in specific areas, which increases the efficiency of the use of this water.

Some of us have presented ideas on how to accomplish this using ecosystem water budgets coordinated by designated "ecosystem trustees" (Mount et al. 2017). Regardless of the approach, there is one basic requirement: the ecosystem must have assets to enable managers to adjust the timing of flow releases and diversions. These assets can include a portion of annual flow that can be flexibly used, stored, or traded; water stored in reservoirs or groundwater basins; shares in storage and conveyance capacity; and financial resources to purchase water.

Managing Tides

Tides drive most water movement and mixing in the Delta and the San Francisco estuary. They are vital for connecting nutrients and supporting food webs across tidal marshes and channels, helping to address food limitations within the Delta. The concept of managing tides may be novel to policymakers, but their ecological relevance is grounded in studies showing that ecosystem productivity increases when different habitat types are connected by tidal flows (Cloern 2007).

Tools for managing tides include changing the Delta's landscape and channels, as well as using gates and barriers. For example, restoring large tracts of tidal marsh will expand the area inundated by tides and dissipate tidal energy, reducing tidal influence elsewhere in the Delta. Gates and barriers can be used to direct tidal flows at the local scale, helping to move food resources (and fish) into or out of specific areas. Landscape changes that do not consider tidal effects can lead to unanticipated or unwanted consequences.

Six Recommended Flow-Tide-Landscape Projects

To improve food webs, maximize habitat for desirable plants and animals, reduce impacts of algal blooms, and increase understanding of the Delta, we recommend a 15-year commitment to a suite of six linked projects. Five of these projects focus on managing landscapes, tides, and freshwater flows—principally within the North Delta, Suisun Marsh, and the Sacramento River floodplains. The sixth project focuses on building and applying knowledge to reduce the human and environmental health risks of algal blooms.

- ***Flood bypasses****:* Yolo and Sutter Bypasses—the two large flood bypasses on the Sacramento River—have the greatest potential for reestablishing floodplain function

in the Central Valley and enriching downstream food webs. Water can be directed through weirs onto floodplains to maximize habitat for migratory fishes (e.g., splittail and juvenile salmon), waterfowl, and wading birds. This requires operable weirs to test and refine management actions, improve ecological outcomes, and allow summer agriculture. This approach also may require pulse flow releases to augment natural flows.

- ***Terminal channel systems***: The North Delta and Suisun Marsh both have networks of dead-end channels that commonly host abundant native fishes (Moyle et al. 2012, 2014). Tidal mixing within these channels is associated with turbid water—which fish may use to avoid predators—and high food web productivity. In the mixing zone of the Deep Water Ship Channel, for example, Delta smelt and other native fish densities are as high as anywhere in the Delta (Feyrer et.al. 2017). Landscape changes and freshwater flow pulses can be used to manage these mixing zones in the North Delta to increase productivity. In Suisun Marsh, the salinity control gates could be used to help meet this objective.
- ***Shallow open-water habitat***: The Delta has approximately 20 square miles of shallow freshwater habitat, mostly in areas where levee breaches have flooded agricultural lands. Landscape changes may be able to enhance food production in these lake-like areas and transfer it to less productive adjacent channels (Lopez et al 2006). Experiments are needed to test this potential source of productivity.
- ***Tidal transition zones:*** Zones where rivers meet the tides account for a large fraction of juvenile salmon mortality within the Delta (Perry et al. 2018). Seaward of these zones, river flows have little influence on the tides, and correspondingly little impact on mortality. Ongoing research shows that it may be possible to increase juvenile salmon survival in tidal transition zones by restoring marshland and making other landscape changes that reduce the influence of the tides in the North Delta. Strategic, short-duration freshwater flow pulses—coupled with improved channel margin habitat—may also help.
- ***Tidal marsh habitat****:* Marshes, including their networks of branching ("dendritic") channels, are some of the most productive, high-quality habitats within the Delta and estuary (Moyle et al. 2014). They also form an important link with upland and wetland areas, promoting the exchange of nutrients and animals essential for this productivity. Creation of new marsh-channel systems is essential and will be most effective in large (1,000+ acre) interconnected areas where they were historically abundant (e.g., in the Cache-Lindsay Slough region and Suisun Marsh; see Robinson et al. 2016). Ongoing research shows that pulses of freshwater flow into Cache Slough have promise for improving habitat and food productivity.
- ***Algal blooms****:* A two-pronged approach is needed to address the problem of harmful algal blooms in the Delta: 1) investigating relationships among flows, water quality, and cyanobacteria blooms; and 2) managing freshwater flows, tides, nutrients, and landscapes to reduce these blooms while promoting productivity for Delta food webs.

Except for the management of harmful algal blooms, all of the projects described above are detailed in some form in numerous state planning and regulatory documents

(e.g., Bay-Delta Conservation Plan, Delta Plan, California EcoRestore). The San Francisco Estuary Institute has also produced an excellent summary of opportunities for habitat improvement (Robinson et al. 2016). Our proposed approach emphasizes two overarching recommendations: that priorities be based on geography, and that actions combine—wherever appropriate—the flexible allocation of freshwater flows with the management of tides and landscapes.

Why This Approach Is Better than the Current Path

Federal and state efforts to manage the Delta for ecosystem objectives have been unsuccessful, as indicated by declines in native biodiversity and water quality (Gore et al. 2018). The approach outlined here departs from historical efforts in two ways. First, we propose an *integrated* approach that considers the complex interaction among tidal and river flows, landscapes, and water quality. Past approaches have failed to consider that the benefits of environmental flows depend on their landscape setting, and that the benefits of landscape changes depend on their hydrologic setting.

Second, we take an *ecosystem-based* view that includes, but extends beyond, population declines of some native fishes listed under federal and state endangered species laws. The integrated approach seeks to improve Delta ecosystem conditions for a broad range of benefits, including fish and wildlife habitat as well as human uses of the Delta's lands and water.

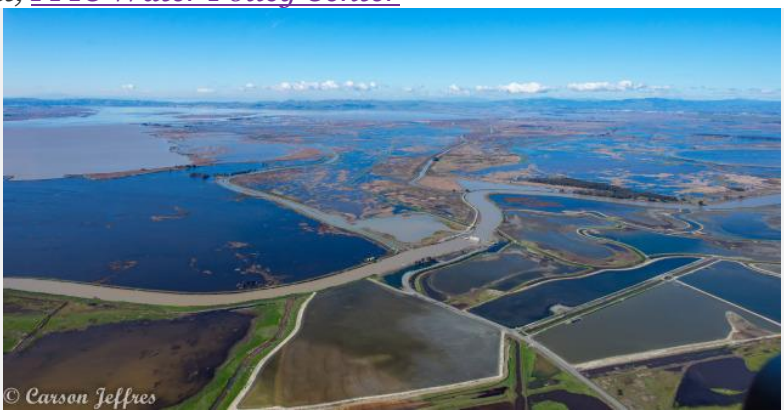
In our view, this integrated approach is more likely to achieve positive results and efficient use of resources than the current path. And by focusing on the North Delta and Suisun Marsh, measurable benefits can be achieved within a 15-year time frame. To be successful, however, this approach must be supported by a robust, well-funded, and trusted science program—a subject that will be explored in our next blog post.

**This blog post summarizes some of the ideas generated by an informal group of experts who have met several times to explore concepts for better management of the Delta. Group members include (in alphabetical order): Jon Burau (US Geological Survey [USGS]), Jim Cloern (USGS), John Durand (UC Davis), Greg Gartrell (consulting engineer), Brian Gray (PPIC), Ellen Hanak (PPIC), Carson Jeffres (UC Davis), Wim Kimmerer (San Francisco State University), Jay Lund (UC Davis), Jeffrey Mount (PPIC), and Peter Moyle (UC Davis).*

Advice on Voluntary Settlements for California's Bay-Delta Water Quality Control Plan Part 3: Science for Ecosystem Management

Posted on February 27, 2018 by UC Davis Center for Watershed Sciences

*by Jeffrey Mount, PPIC Water Policy Center**



The Delta. Photo credit: Carson Jeffres

Recommendation

Improving Delta ecosystem functions under the State Water Board's proposed Bay-Delta Water Quality Control Plan will require a complex series of changes to water and land management—and a strong science program to guide actions. This science effort will need to go well beyond current Delta science programs in scope, authorities, and funding. The most promising approach is to expand the existing Delta Science Program and grant it the authority and responsibility to support the plan. As part of this effort, parties engaged in the Delta should create a Delta Science Joint Powers Authority (JPA) to better pool and administer science resources to be used by the Delta Science Program. The JPA also would be a forum for agencies, water users, and other stakeholders to develop consensus and collaborations on science-based management.

Introduction

The State Water Board is updating its Water Quality Control Plan for the Sacramento-San Joaquin Delta. Multiple parties that would be affected by this plan are seeking to negotiate voluntary settlement agreements for the Board to consider. In two previous posts, a group of us* have suggested that the Board and negotiating parties take a new approach to resolving some of the Delta's ecological and water supply problems.

The first post calls for integration of freshwater flows with tide and landscape management to improve food web productivity, maximize habitat for desirable plants and animals, and reduce the impacts of harmful algal blooms. The second post describes a suite of actions to meet these objectives.

This approach cannot succeed without a strong science program that is well-funded, authoritative, and useful. Most important, this science program must go beyond meeting the traditional interests of specific state and federal agencies and integrate science to meet broader objectives. It must also be an integral part of any adaptive management program. In this blog post we propose a science effort to inform and assess the implementation of the Water Quality Control Plan.

Science in the Delta Today

The San Francisco Estuary, including the Delta, is one of the most studied in the world (Cloern and Jassby 2012, Healey et al. 2016). Science and monitoring is done by many state and federal agencies, water utilities, water user organizations, universities, stakeholder groups, and a large network of consultants (summarized in Hanak et al. 2013 and Gray et al. 2013). Many reviews of the science enterprise in the Delta have recommended reforms. Two particularly useful reviews are by the National Research Council (2012) and the Delta Independent Science Board (DISB 2016, Weins et al. 2017). Several persistent themes from these reviews inform the proposals made here. These include:

- Conflicting agency goals lead to fragmentation of scientific efforts (Lund and Moyle 2013);
- Divergence among preferred actions of different organizations — combined with fragmented science administration — leads to advocacy-based or "combat" science, pitting different organizations against each other in their scientific efforts;
- The lack of reliable funding — and the inability to deploy it quickly — hampers the ability to conduct innovative science and monitoring, respond to new opportunities and information, and sustain vital long-term investigations.

Since the publication of the 2012 National Research Council report, there have been efforts to improve Delta science, principally through cooperation and collaboration among the many current efforts. But as the NRC report pointed out, "collaboration does not equal integration." While these efforts have improved the quality of the science, they are not sufficient to support the integrated, ecosystem-based management program recommended in our previous posts.

Matching Science with Management Goals and Objectives

In our view, no single state agency has the capacity or authority to guide the implementation of the ecosystem management actions needed over the next 15 years. In addition, science funding has been unreliably based on a boom-bust cycle of state bonds and other sources; it has been unable to support the sustained research needed to inform and improve management. However, we believe the building blocks for an effective science program exist. The core of our proposal is to elevate the existing Delta Science Program (DSP) by granting it responsibility and resources to guide the science needed to implement the Water Quality Control Plan.

The Delta Science Program was established by the 2009 Delta Reform Act. Its mission is to provide the best available science for decision making in the estuary and watershed. The DSP answers to the Delta Stewardship Council, which appoints its lead scientist and approves the program's budget. The program also houses the Delta Independent Science Board—a group of distinguished scientists and engineers who advise on scientific issues. At present, the DSP primarily tries to coordinate the many disparate science activities in the Delta, develop syntheses on important topics, and run modest grant and fellowship programs.

Although the DSP is structured to do just the kind of integrated science needed to meet the needs of the Water Quality Control Plan, it lacks the necessary budget and authority over the science agenda. We propose expanding its mission and finding creative ways to grant it the financial and institutional capacity to succeed.

The New Delta Science Program and Delta Science Joint Powers Authority

The Delta Science Program should be given resources and decision-making authority to:

- Work with agencies, water users, and other stakeholders to develop a science action plan to meet the Water Quality Control Plan's ecosystem-based objectives and, where possible, the broader science needs of state and federal agencies and stakeholders;
- Build capacity to project outcomes of flow-tide-landscape investments with integrated hydrodynamic, ecologic, and economic models supported by data collection networks;
- Coordinate protocols and data for monitoring in the estuary and the watershed to inform the Water Quality Control Plan;
- Implement and oversee a science program that can guide management actions as experiments and assess outcomes and performance measures;
- Build trust and promote consensus on the science used to inform decision making (recognizing that there will never be consensus on the decisions themselves).

The DSP has a good foundation to take on this task. Its 2016 *Delta Science Plan* and 2017-21 *Delta Science Action Agenda* cover many of the proposals in our earlier posts, and could readily be adapted to organize the science needed to guide implementation of the Water Quality Control Plan. In addition, the DSP already has a governance structure that provides both administrative oversight (by the Delta Stewardship Council) and scientific oversight (by the Delta Independent Science Board and review panels).

Placing the DSP in charge of science for the Water Quality Control Plan is insufficient, however, given both funding and institutional constraints. To overcome these hurdles, we suggest that the DSP be the core of a new Delta Science Joint Powers Authority (JPA). This JPA would be modeled, in part, after a successful water quality research effort in Southern California. The Southern California Coastal Water Research Program (SCCWRP) is a JPA that unites sanitation and stormwater agencies with water-quality regulating agencies. Together, these parties develop and fund a common scientific effort to support management and monitoring decisions on stormwater and wastewater. This program—which has also benefitted from excellent leadership—shows how to develop high quality, useful, and consensual science support for policy and management decisions.

Like SCCWRP, the Delta Science JPA would be funded and overseen by a group of regulated and regulatory entities and other parties. It would be chaired by the DSC, with a science program led by the DSP's lead scientist. State and local public agencies would be signatories to this effort and contribute financial support or personnel. Federal agencies cannot sign JPA agreements, but they can contribute resources and serve on the JPA board. The JPA board can also include non-governmental stakeholder representatives, such as environmental non-profits. In this way, the parties affected by and overseeing the Water Quality Control Plan would have an opportunity to pool

resources and build consensus on a science agenda and integrate scientific findings and actions.

The JPA structure provides a better way to fund scientific research and experimentation than is currently available to the DSP or other state agencies. JPAs can exercise authorities granted to any signatory agency. Because local agencies generally have more flexibility to administer funds than state agencies, the JPA will be able to write contracts to support research and monitoring activities more quickly (days instead of many months), and with less overhead. At present, difficulties in securing timely contracts from state and federal funders present a hurdle to science in the Delta and lead to missed opportunities for research by agencies, universities, non-profits, and private consultants.

We estimate that $20 to $30 million annually is needed to fund this science program. (This is in addition to the current DSP budget of approximately $10 million, and does not count planned restoration efforts or monitoring activities currently being conducted by agencies.) Without a budget of this scale, there is little hope for a successful, collaborative, science-based ecological management program in the Delta. Funding sources could include pooled contributions from JPA members, contracts for research, appropriations from the state General Fund, and small fees on the use of water originating in the watershed and the discharge of pollutants into waterways both upstream of and within the estuary. For example, a $1/acre-foot fee on water use would generate more than $20 million annually.

In conclusion, we believe this proposed approach—elevating the Delta Science Program and anchoring it within a new Joint Powers Authority—is a practical and effective way to develop the scientific support needed to guide, evaluate, and adapt implementation of the Water Quality Control Plan. It builds on existing institutions while establishing a way to build consensus around a science agenda, pool and use resources more efficiently, and tailor a science program to meet the needs of an integrated, ecosystem-based approach to improving ecosystem conditions in the Delta.

**This blog post summarizes some of the ideas generated by an informal group of experts who have met several times to explore concepts for better management of the Delta. Group members include (in alphabetical order): Jon Burau (US Geological Survey [USGS]), Jim Cloern (USGS), John Durand (UC Davis), Greg Gartrell (consulting engineer), Brian Gray (PPIC), Ellen Hanak (PPIC), Carson Jeffres (UC Davis), Wim Kimmerer (San Francisco State University), Jay Lund (UC Davis), Jeffrey Mount (PPIC), and Peter Moyle (UC Davis).*

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Is Ecosystem-Based Management Legal for the Sacramento-San Joaquin Delta?

Posted on March 8, 2018 by UC Davis Center for Watershed Sciences

*by Brian Gray (PPIC Water Policy Center), William Stelle (former NOAA Fisheries West Coast Administrator), and Leon Szeptycki (Stanford University, Water in the West)**

Introduction

In a recent three-part series posted on this website, a group of independent experts (including one of the authors here) proposed new ways to manage the Sacramento-San Joaquin Delta ecosystem. The purpose of the recommendations is to inform negotiations on the revised Bay-Delta Water Quality Control Plan, which will set new water quality and flow requirements for the Delta and its tributaries.

These experts urged the State Water Board and negotiating parties to: (1) take an integrated approach to the Delta to improve food web productivity and habitat, while reducing harmful algal blooms; (2) coordinate management of freshwater flows, tidal energy, and landscape changes in the North Delta and Suisun Marsh to improve ecosystem function; and (3) develop a robust, well-funded independent science program to guide implementation and assessment of the water quality plan.

The experts note that populations of native fish species listed under the state and federal endangered species acts are so low that they are no longer reliable indicators of Delta conditions. They recommend shifting away from an emphasis on managing the Delta for these listed species. And they outline an ecosystem-based approach that would improve conditions for a wide range of terrestrial, wetland, and aquatic plants and animals—including listed fish species—as well as for human uses of the Delta's water and lands.

These recommendations are intriguing, especially in light of growing consensus that the current approach to water quality and species protection in the Delta is failing to meet legal and policy objectives. But would management based on the proposed policies be legal?

Ecosystem-Based Management

An ecosystem-based approach to the Delta would differ in several important respects from the existing regulatory regime. Current regulations rely heavily on minimum flow and water quality standards, which are often met by releases from upstream reservoirs. These regulations also impose a variety of constraints on Central Valley Project (CVP) and State Water Project (SWP) operations—including seasonal restrictions on water exports from the south Delta—to minimize reverse flows and prevent dislocation and entrainment of fish.

The proposed approach calls for more flexible deployment of releases from upstream reservoirs to improve aquatic habitat, along with landscape changes to enhance habitat benefits from managed freshwater and tidal flows. The proposal also advocates focusing conservation and

recovery actions on an arc of habitat from the Yolo Bypass through the North Delta and into Suisun Marsh (the "North Delta Arc"), which has been less altered by human interventions and is linked by the Sacramento River. This area has a greater likelihood of producing significant, near-term ecological improvements compared with conservation actions elsewhere in the Delta. The proposal also would alter the current strategy of using large volumes of freshwater outflow to manage salinity in the Delta and Suisun Bay, choosing instead a geographically targeted approach to the application of freshwater flows.

Although it would represent a marked change from existing regulatory policy, an ecosystem-based strategy would be consistent with the water quality laws and the endangered species acts.

The Water Quality Laws

California's Porter-Cologne Act implements the federal Clean Water Act and establishes independent state standards for water quality. It requires the State Water Board to set water quality standards that provide "reasonable protection" for an array of beneficial uses of the waters of the Delta ecosystem, including fish and wildlife *and* water supply. The courts have held that the Board has broad authority to determine what water quality criteria are reasonable and appropriate in light of competing demands on the resource, as long as its decision is supported by substantial evidence in the administrative record.

The Porter-Cologne Act thus grants the Board significant discretion to choose how best to deploy the freshwater available in the Delta. For example, if the Board concludes that the North Delta Arc is the most productive habitat for conserving and recovering protected species, then it would have authority to set water quality standards (including targeted flow requirements) that make this a priority region. If the Board is also persuaded that the central and south Delta are now unproductive and inhospitable habitat for native fish species, it could adjust salinity and flow standards accordingly.

In short, because of the multifaceted and flexible authority vested in it by the water quality laws, there is no significant legal impediment for the State Water Board to follow an ecosystem-based approach in revising its water quality standards for today's Delta.

The Endangered Species Acts

The federal and state endangered species acts pose more difficult questions because they contain more rigid directives than do the water quality laws. Rather than setting standards to accommodate a variety of beneficial uses, these laws categorically prohibit the unauthorized "taking" of any protected fish. The federal statute also requires all federal agencies to ensure that their actions are not likely to jeopardize the continued existence of any listed species or adversely modify their critical habitat. Takings that are "incidental" to otherwise lawful activities—including water diversions and other water project operations—may be authorized by incidental take statements in biological opinions or by incidental take permits for non-federal activities. Both laws require the impacts of authorized takings to be "minimized," and the state statute requires that they also be "fully mitigated."

These laws govern water management in the Delta ecosystem principally as applied to the coordinated operations of the CVP and SWP, which must comply with a series of conditions set forth in biological opinions issued by the U.S. Fish and Wildlife Service (USFWS) for Delta smelt and by the National Marine Fisheries Service (NMFS) for anadromous species (salmonids and green sturgeon). The California Department of Fish and Wildlife (CDFW) plays a complementary role. Its principal regulatory authority in the Delta is through the longfin smelt incidental take permit issued to the SWP.

Legal Questions

The proposed ecosystem management approach raises several key legal questions to which we provide brief answers:

- *Is an ecosystem-based approach to water quality and species protection consistent with the federal and state endangered species acts?*

Yes. Although the focus of the endangered species acts is on individual species and their critical habitat, there is nothing in the statutes that would preclude the fish agencies from adopting a more holistic and integrated approach—if the best scientific evidence supports the decision that the ecosystem objectives would be an effective means of fulfilling the no jeopardy/adverse habitat modification standards, as well as the mitigation requirements associated with the incidental take of each listed species.

Indeed, this legal question can be framed in a relatively simple way: What are good scientific metrics for predicting and assessing ecosystem functions (e.g., food web productivity) on which each species relies for its survival and recovery, and are these better expressed as ecological system metrics, rather than through the salinity, flow, and temperature metrics that are currently employed? If the ecosystem approach would be a better way to protect and enhance the biological requirements of each listed species, the fish agencies could approve it under the conventional consultation and incidental take regulatory processes.

- *Could the federal fish agencies revise the biological opinions for CVP/SWP operations to recognize the proposed focus on a North Delta Arc of critical habitat?*

Yes. If the agencies conclude that creation of a North Delta Arc of habitat would promote the applicable conservation standards for each of the federally listed species, they would have authority to incorporate this strategy into the biological opinions. As noted above, these could include changes in upstream storage and release requirements to provide targeted flows into the Sutter and Yolo Bypasses, as well as other tidal sloughs and channels, to improve food webs and aquatic habitat.

- *Could the federal agencies revise the biological opinions to recognize a geographically specialized Delta ecosystem that reduces the emphasis on the central and south Delta as critical habitat for some species?*

Yes. The federal endangered species act does not require conservation and recovery of listed species throughout their entire range of existing or potential habitat. It also affords the fish agencies considerable flexibility in setting priorities for habitat types and locations—if these conservation strategies would satisfy the no jeopardy/critical habitat directives for each listed species.

Therefore, if the best scientific evidence supports the conclusion that the central and south portions of the Delta are irreparably degraded and that the North Delta Arc is now the most promising habitat for the Delta smelt, the USFWS could adopt geographic specialization as a conservation strategy. This would be accompanied by changes in the critical habitat designation for the smelt, as well as adjustments in the incidental take limitations for the CVP and SWP south Delta pumps to account for this change in focus.

Similarly, NMFS could conclude (also based on the best available science) that the most promising habitat for Sacramento River salmonids is the North Delta Arc. Based on this determination, it too could shift the focus of its conservation and recovery directives to that region. The salmonid biological opinion also would have to include measures to promote passage of salmon and steelhead in the central and south Delta and lower San Joaquin River. As there is no scientific consensus on this subject, we recommend that NMFS—in cooperation with CDFW and the State Water Board—convene a small independent panel of creative scientists and engineers to evaluate the options.

- *Could the California Department of Fish and Wildlife revise the State Water Project's incidental take permit for longfin smelt to recognize a specialized Delta ecosystem?*

Yes. Although the longfin smelt once inhabited much of the Delta, its current population exists primarily in San Francisco Bay. As with federal law, the California Endangered Species Act does not require conservation and recovery of listed species throughout the full extent of their habitat, and it grants CDFW discretion to create priority habitat characteristics and locations. The department therefore would have authority to make the North Delta Arc (which once was important spawning habitat for the smelt) the focus of its conservation and recovery efforts.

Longfin smelt are anadromous and depend on freshwater and tidal flows in the Delta and Carquinez Strait. CDFW would have to ensure that the North Delta Arc conservation and recovery strategy would provide conditions that enable the fish to migrate between their freshwater and more saline habitats.

In addition, in revising the SWP's incidental take permit, the department must determine that the North Delta habitat improvements would "fully mitigate" any adverse effects of the change in policy. Restoration and long-term enhancement of intertidal and sub-tidal wetlands in the North Delta is already part of the mitigation requirements of the SWP's incidental take permit. If necessary to offset any risks posed to the smelt from the new habitat strategy, CDFW could require the acquisition and management of additional mitigation acreage.

Concluding Thoughts

Ecosystem-based management in the Delta may be a more efficient and effective means of implementing the water quality laws and endangered species acts than the current regulatory regime. Whether this is true will depend on the responses of the ecosystem and the fishes that inhabit it to the combination of targeted freshwater flows, tidal energy management, and landscape changes that would be concentrated along the North Delta Arc.

To test this new strategy, regulators, water managers, and environmental advocates must be willing to assume the risk of moving away from entrenched policies that have largely failed to achieve their objectives. The judgment whether the new approach is the "best available science"—and therefore may serve as the foundation for a revised water quality control plan and new biological opinions—rests with the regulators. We can simply say that there is nothing in state or federal law that would preclude such a decision.

More importantly, the strategy proposed in the earlier blog posts illustrates a foundational—but often neglected—principle of aquatic ecosystem management: Protection of water quality and conservation of species are one in the same, and neither can be achieved without the other. Perhaps the greatest contribution of the new Delta science will be to encourage the State Water Board and the fish agencies to work together to devise truly integrated standards for today's novel Delta ecosystem.

** With contributions and insights on the intersections between law and science from Peter Moyle and Jay Lund (UC Davis) and Jeff Mount and Ellen Hanak (PPIC Water Policy Center).*

Further Reading

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